UDK 629.331 (075.8)

ANALYTICAL METHOD OF DIAGNOSING MALFUNCTIONS

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Abstract: This article describes the causes, the characters, and the devision into the groups of complexity of faults, the topical issue of pre- diagnosis of faults which is showed accurate calculations based on reality parametrs.

Keywords: Fault, maintainability, vehicles, repair, performance capability, probability, technical systems, analytical, diagnostics, reliability, time, information.

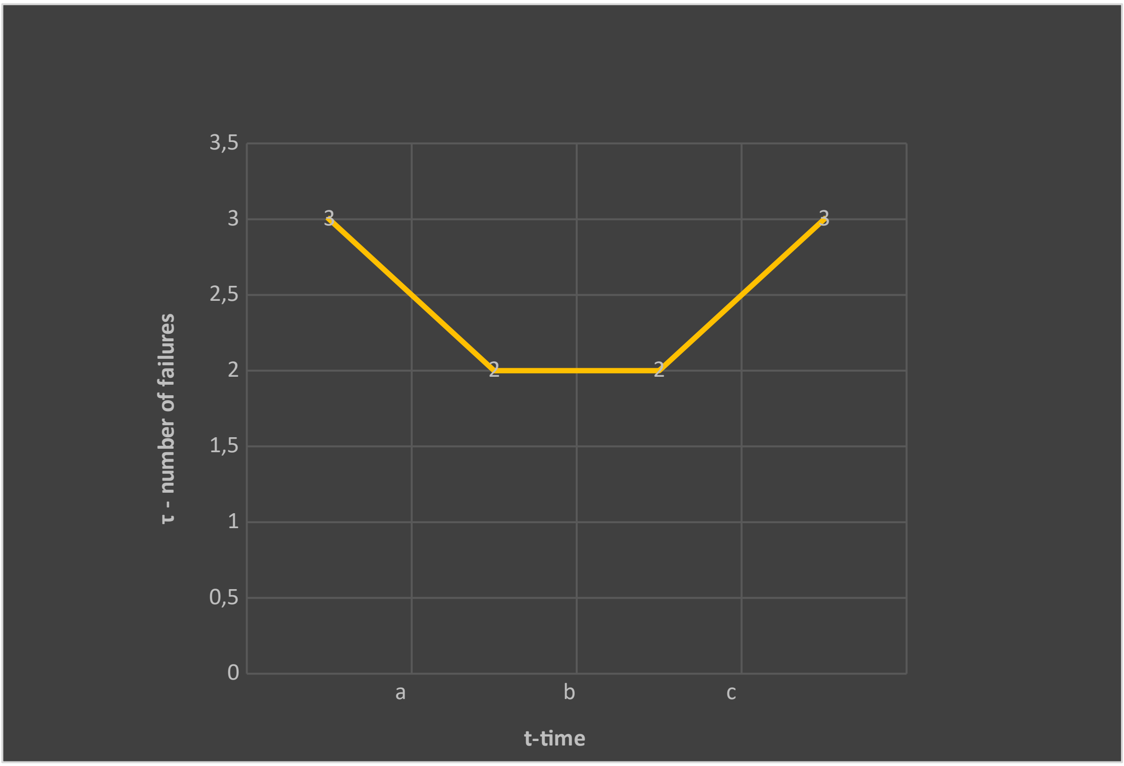
Introduction. The causes of faults can be varied. These are incorrect calculations due to errors made at the design and development stage, production defects, violation of operating rules and regulations, damage, as well as natural wear and tear processes.1]

Malfunction symptoms indicate the direct or indirect effect of phenomena characteristic of the inoperative state of objects or processes associated with them on the driver's senses and identify specific changes occurring in the object.

For many technical systems, and in particular for vehicles, the dependence of the intensity of failures on the operating time is characterized by three periods, which correspond to the three "lives" of these systems.[2]

The first type of character ("section a") is characterized by a monotonic decrease in the failure rate. This corresponds to the running-in period, during which defects in technology and manufacturing appear, not inherent in the design.. [2]

The second type of character ("section b") corresponds to the constancy of the failure rate. This corresponds to the period of normal operation. During this period, as a rule, sudden failures characteristic of the design itself appear and their number, as well as the frequency of their occurrence, do not depend on the operating time.[2]



1-rasm. Nosozlik jadalligining vaqtga bog'liqligi

The third type of character ("section c") reflects a constant increase in the failure rate. This corresponds to the period of wear and tear, arising as a result of aging processes. During this period, mainly gradual failures occur.[1]

Failures are usually classified according to a number of criteria. We will consider the division of failures into groups of complexity.

The first group of failures includes failures that can be eliminated without disassembling various units or systems of the object into parts, and they can be eliminated at the maintenance station.

The second group of failures includes failures that can be eliminated by repairs or by replacing easily replaceable units and systems, as well as failures that can be eliminated by opening the internal cavities of the main units (without disassembling them) or at the maintenance station-2.

The third group of failures includes failures that require disassembly of the main units. Failures of this group are eliminated in specialized repair enterprises or in central repair shops (CRS)..[2]

Materials and methods. To reduce the number of failures of this type in vehicles, it is necessary to carry out diagnostic calculations in motor transport enterprises based on accurate calculations, which serve to increase the reliability of the vehicle and reduce the number of breakdowns. As a complex characteristic, the reliability of a vehicle consists of a combination of properties: failure-free operation, durability, maintainability and preservability. Therefore, the assessment of reliability is carried out separately according to the indicators of individual properties based on the results of monitoring the operation of these objects. It is advisable to determine the reliability indicators for the operating time interval as well as for the entire observation period separately. To do this, all failures of each vehicle should be distributed over the operating interval. Then the conditional number of vehicles operating at a given interval obeys the following formula:

$$N_y = \sum_{i=1}^{N} (t_i) / \Delta t, \qquad (1)$$

where: $\sum_{i=1}^{N}(t_i)$ - the sum of the operating time of all vehicles in a given interval, thousand km; Δt-- the interval value, thousand km.

The average number of failures per vehicle in a given interval is determined as follows:

$$r_{cp}=\sum_{i=1}^{N} r_{i(\Delta t)}/N_Y, \quad (2)$$

where: $r_{i(\Delta t)}$ - i- is the number of failures of the car in a given interval.

$$\omega(\Delta t)=\frac{r_p(\Delta t)}{\Delta t}. \quad (3)$$

Then the average value of the failure flow parameter for the entire observation period is determined by the formula:

$$\omega=\frac{\sum_{i=1}^{N} r_i}{\sum T}, \quad (4)$$

where: $\sum_{i=1}^{N} r_i$- the total number of failures for all vehicles during the observation period;

ΣT- total operating time for all trucks during the observation period, thousand km.

The mean operating time to failure in a given interval, T_0, is determined by the formula: $T_o=\frac{1}{\omega(\Delta t)}$, (5)

The average trouble-free service life of all means of transport during the observation period is expressed by the following formula:

$$T_o=\frac{\sum T}{\sum_{i=1}^{N} r_i}=\frac{1}{\omega}. \quad (6)$$

The probability of trouble-free operation of vehicles within specified interval boundaries is determined by the formula:

$$P(t,t+\Delta t)=e^{-\omega(\Delta t)\Delta t}. \quad (7)$$

The repair performance indicator - the average time to restoreoperability is determined. The average time to restoreoperability is determined during the observation period of vehicles by the eliminated failures as follows:

$$T_{в.ср}=\frac{\sum_I^N t_b}{\sum_I^N r_{устр}}, \qquad (8)$$

where: $\sum_I^N t_b$ – the total time to restoreoperability.

The coefficient of readiness - a complex indicator characterizing the maintainability and trouble-free operation of observation objects, is determined by the following formula:

$$K_T=\frac{x\times T_0}{x\times T_0+T_{в.ср}}, \qquad (9)$$

where: x-conversion coefficient of a truck's operating time unit to a clean operating hour.

Ushbu koeffitsiyent quyidagicha aniqlanadi:

$$x=\frac{1}{W_T}, \qquad (10)$$

where: W_T- Theoretical efficiency of vehicles.

The operating time of vehicles until perfect repair (PR) is estimated by γ – percent of the resource. For this purpose, the values of the vehicle resources (variation series) are arranged in ascending order. We compile statistical data on digital values of information, mean of information, frequency, experimental probability (frequency), and cumulative experimental probability. We divide all the information into intervals, the number of which is determined by the following formula:

$$n=\sqrt{N}, \qquad (11)$$

where: N- number of information.

The length of one interval, A, in thousand kilometers, is determined by the following formula:

$$A = \frac{T_{max} - T_{МИН}}{n},\qquad (12)$$

where: T_{max} and T_{min}- most frequent and least frequent values in a statistical series.

Moreover, the length of the interval is rounded up to a multiple. The displacement value tsm is determined by the formula:

$$t_{sm} = T_{DrI} - \frac{A}{2},\qquad (13)$$

where: T_{Dr1}- the value of the resource at the first information point (the smallest resource), thousand kilometers..

The first row of the statistical series is constructed using the number of intervals and their lengths. The second row of this row indicates the middle of each interval. The third row shows the frequency, i.e. the number of values falling into each resource interval. In this case, if there are several equal resource values on the border of two intervals, they are evenly distributed between these intervals.

Axborot nuqtalarining bir yoki bir nechta qiymatining oxirgi oraliq chegarasidan chiqib ketadigan bo'lsa, A oraliqlar uzunligini oshiramiz. Har bir P oralig'ida ishonchlilik ko'rsatkichi ko'rinishining eksperimental ehtimoli qiymatlari quyidagi formula bilan aniqlanadi:

$$P_I = \frac{m_i}{N}.\qquad (14)$$

The value of the cumulative probability or frequency is determined by the formula by adding the probabilities over the intervals of information:

$$\sum_{i=1}^{n} p_i = \sum_{i=1}^{n} \frac{m_i}{N} = \sum_{i=1}^{n} m_i.\qquad (15)$$

We form all the necessary directions of the statistical distribution up to the repair resources of vehicles. Then, we determine the main numerical characteristics of the resource distribution; its mean value , the mean square deviation σ, and the variation coefficient V. The mean square deviation σ is an absolute measure, and the variation coefficient is a relative measure of the dispersion of random variables. The mean resource value is determined by the following formula:

$$T_{DR} = \sum_{1}^{n} T_{CRi} P_i, \quad (16)$$

T_{CR_i} - the value of the resource in the middle of the i-th interval;

P_i - experimental probability in the i-th interval.

The mean square deviation is calculated by the formula:

$$\sigma = \sqrt{\sum (T_{cpi} - T_{ДР}) \times P_i}. \quad (16)$$

We calculate the variation coefficient by the formula:

$$V = \frac{\sigma}{T_{ДР} - t_{cm}}. \quad (17)$$

We carry out an experimental value test for the Irvin meson:

$$\lambda_{ОП} = \frac{T_i - T_{i-1}}{\sigma}, \quad (18)$$

where: T_i and T_{i-1}- interchangeable points in the information table.[6]

Results and discussion. Let's compare the obtained values with the table values of the Irvin meson. If $\lambda_{OP} < \lambda_T$, then the information is reliable, if $\lambda_{OP} > \lambda_T$, unreliable. [6]

Conclusions. Summing up, we can say that the analytical prediction of failures is one of the main problems of modern motor transport enterprises. Checking the reliability of information on the Irvin meson in solving this problem reduces the period before the perfect repair of the vehicle and can provide motor transport enterprises with accurate information about the repair time of vehicles. This, in turn, will allow motor transport enterprises to direct funds for repairs in advance.

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